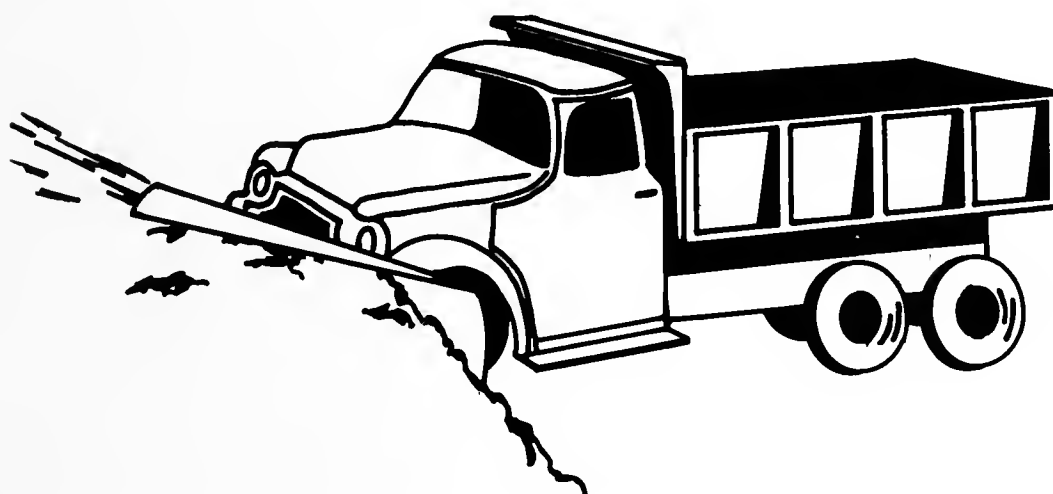


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ENGINEERING STUDY OF SELECTED LOCATIONS EXPERIENCING HIGH ACCIDENT FREQUENCY UNDER SNOWY AND ICY ROADWAY CONDITIONS



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ENGINEERING DIVISION
MONTANA DEPT. OF HIGHWAYS

IN COOPERATION WITH

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INTRODUCTION

The Montana Department of Community Affairs - Highway Traffic Safety Division and the Montana Department of Highways entered into contract to conduct engineering studies of twenty-two selected sections of roadway, statewide, that have experienced the highest accident occurrence under snow covered or icy roadway conditions. This project was accomplished with the cooperation of the Federal Highway Administration and other agencies.

Highway Traffic Safety Division identified the twenty-two roadway sections by the use of the Highway Information System Accident Computer Program. Each roadway section consisted of ten miles in length. Fifteen of the roadway sections were located on the Federal Aid Interstate System. The remaining seven were located on the Federal Aid Primary System. The majority of the roadway sections were located in the western portion of Montana where heavily forested mountainous type terrain prevails. Many of the identified roadway sections included roadways that traverse high mountain passes. Other predominant sections included roadways near cities where high population and high traffic volume exposure exists. Accident frequency was prevalent at interstate interchanges and major intersections.

Following is a listing of the areas identified as experiencing the highest snowy and icy roadway accident frequency statewide initiating concern for engineering studies and this report:

<u>F. A. ROUTE</u>	<u>NUMBERED ROUTE</u>	<u>MILEPOST</u>	<u>LOCATION</u>
1. I 15	I 15	120-130	Butte East and West
2. I 90	I 90	0-10	Idaho Border East (Lookout Pass)

3. I 90	I 90	30-40	St. Regis East and West (Omitted)
4. I 90	I 90	80-90	Frenchtown West
5. I 90	I 90	100-110	Missoula East and West
6. I 90	I 90	130-140	Missoula - Drummond
7. I 90	I 90	140-150	Missoula - Drummond
8. I 90	I 90	170-180	Garrison
9. I 90	I 90	230-240	Butte - Whitehall (Homestake Pass)
10. I 90	I 90	300-310	Belgrade - Bozeman
11. I 90	I 90	310-320	Bozeman - Livingston (Bozeman Pass)
12. I 90	I 90	320-330	Bozeman - Livingston (Bozeman Pass)
13. I 90	I 90	330-340	Livingston East
14. I 90	I 90	370-380	Big Timber East (Omitted)
15. I 90	I 90	430-440	Laurel East and West
16. FAP 1	US 2	140-150	Columbia Falls - Northeast
17. FAP 1	US 2	210-220	East Glacier - Northeast
18. FAP 5	US 93	0-10	Missoula - North
19. FAP 24	MT 200	0-10	Bonner - East
20. FAP 50	US 191	50-60	Bozeman (Gallatin Canyon)
21. FAP 50	US 191	60-70	Bozeman (Gallatin Canyon)
22. FAP 86	MT 86	0-10	Bozeman (Bridger Canyon)

All accident history for each study area was collected for the time periods of January 1, 1972 to the latest available in the computer information system. The accident data included all accidents and was not limited to those only occurring

when the roadway was snowy or icy. If reconstruction of the study areas occurred after January 1, 1972, accident information was applied from the date the roadway was opened to thru traffic. Construction zone accidents were not used. Some of the study areas were either under construction or had recently been opened to traffic and little or no accident information was available. These areas were omitted from the engineering study project.

Accident collision diagrams showing placement of each accident and the type of collision was prepared on highway construction plans for each study area. Additional statistical accident information pertaining to the particulars of each accident was also shown on the collision diagram. Accident analysis computer programs summarizing a variety of statistical accident data to include accident rates and severity rate computations for each area was obtained. The above material was prepared for use in eventual on-site field reviews of the study areas, which were conducted during 1980. the following material summarizes the process, objectives and conclusions of the twenty-two study areas.

OBJECTIVE

Montana, being a snow belt state, is faced with combating snow and ice control on its roadways several months of the year. Accident statistics show that approximately 26.6% of the total accidents that occurred between 1976 - 1979 happened on snowy or icy roadways. Snow, ice, wind, limited visibility, etc., are all major factors affecting the safety of the traveling public during winter driving. These factors are of great concern to agencies responsible for designing, constructing and maintaining highway facilities.

Concentrated efforts, in the winter of 1979, by maintenance personnel, in cooperation with DCA - Highway Traffic Safety Division, was placed at the twenty-two roadway sites identified as experiencing the highest accident frequency during snowy or icy roadway conditions. These efforts included additional sanding operations, increased man hours and equipment.

The primary objective of the engineering studies, was to review and discuss the twenty-two locations by representatives of various governmental agencies as a team to document observations and viewpoints and possibly recommend any changes for future design or other practices that could aid roadway safety during periods of snow and ice conditions. Other recommendations to enhance driver safety on a year around basis was also to be considered. The intent of the study was to perform on-site reviews of the roadway geometrics, surfacing, traffic control devices and other design applications at the selected sites for comment and possible revisions or changes. Maintenance operations and practices were not the major focus of the study.

Members of various State and Federal Agencies responsible for implementing and administrating highway engineering design, safety and maintenance, formed to comprise a diagnostic team. The diagnostic team performed on-site field reviews of the twenty-two study areas in the summer and fall of 1980. Considerable discussion took place concerning all roadway aspects of the study areas during the course of the field reviews. Particular attention was focused on specific locations within the study areas that showed a grouping or cluster of accidents. The field reviews concluded at each study area with group discussions to exchange observations and viewpoints for possible future design practices and recommendations.

OBSERVATION

During the course of conducting on-site reviews by the diagnostic team, numerous conditions were generally characteristic with every area observed. The following listing summarized some of these predominant conditions:

1. A condition that exists without a satisfactory solution is melting snow running across the roadway during the warm period of the day and freezing at night causing an icing condition. This frequently happens on curve sections when snow build up is not or cannot be pushed far enough off the shoulder on the high side to allow runoff to flow away from the roadway instead of across it.

The state of Indiana installed a pavement drainage system that helped correct an icing condition on a curve that was causing accidents. The drainage system was a slotted drain pipe with a continuous steel grate welded on the slot. The pipe was buried along the shoulder edge on the high side of the curve so the slot is exposed and level with the surface. Water enters the slot to the pipe below and is channeled to an outlet. The objective to catch runoff of melting snow from the shoulder before reaching the traveled way worked successfully.

A similar drainage system has been used on a limited basis in Montana to trap water near a standard catch basin and is also planned be used experimentally on the high side of a curve located on McDonald Pass near Helena or at a similar location experiencing icing conditions.

Disadvantages to the use of these devices for trapping melting snow could increase maintenance upkeep and costs in the event the slotted drain becomes clogged or filled with debris.

2. The design of new highway facilities has incorporated features addressing highway safety and recognize maintenance needs in respect to snow and ice control. Design criteria to elevate roadbeds, provide flat safety inslopes and backslopes and backslope rounding, to name a few, have drastically aided in reducing the length of time roadways are snowpacked or icy. The use of modern engineering designs such as snowfence installations at identified areas where heavy drifting occurs enhances roadway safety by increasing visibility, controls roadway snow and ice and lessens maintenance obligations.
3. Practiced design criteria in some areas contribute to problems in the control and removal of snow and ice. The installation of solid W beam guardrail, in addition to being a roadside obstacle, creates a snowfence action during blizzard conditions causing drifting and reducing driver visibility. The existence of W beam guardrail in some locations does not allow maintenance personnel to remove the snow clear of the roadway surfaces. Wind rowing of snow adjacent to the rail compounds a snowfence condition and can cause roadway icing.

Other elevated appurtenances such as bridge rails, signing and delineation can cause drifting and inhibit proper snow removal and storage.

Channelized intersections using raised barriers to define islands or lane separations for traffic control create maintenance problems during

and after snow storms. These barriers contribute to sheet icing of adjacent pavements if proper grading and drainage structures are not provided.

Bridge decks remain a constant threat to roadway safety during winter months. On super elevated bridges where snow plowing has created snow buildup on the sidewalks or brush curb, snowmelt causes icing if suitable drainage is not provided it becomes clogged. Under specific temperature conditions, bridge decks often freeze and become icy when at the same period the approach to the bridge are clear and dry. During plowing operations, pushing snow to the roadway below on bridges or overstructures which span another highway facility is also of major concern.

Uneven or rutted roadway surfaces can limit complete snow removal and subject the motoring public to an undesirable driving discomfort. This condition can exist on sections where the joining or meet line of the concrete driving surface lane and an asphalt shoulder do not maintain the same elevation.

4. Due to the geographic configuration of the majority of the study areas reviewed a predominant situation existed. Most roadways reviewed traverse heavily timbered mountainous type terrain. These conditions limit the amount of time sunlight is exposed to the pavement surface inhibiting natural and mechanical snowy and ice removal.

Continuous steep mountain hillslopes adjacent to the roadways create shaded areas which lengthens the time snow and ice prevails on the roadway surface at specific locations.

5. A number of completed safety projects were observed that were constructed cost-beneficially on past accident experience. It was apparent the states safety program to identify hazardous locations and work toward effective correction of them is being accomplished.

CONCLUSION

The burden of snow and ice control on Montana's roadways affects in part all governmental agencies responsible for achieving the safest highway facilities possible for the motoring public. Primarily, the major obligation of snow and ice control lies within the operations performed by the jurisdictional maintenance body. This often entails combating natural forces and geographic conditions where no roadway alterations are feasible.

To lighten the burden placed on maintenance obligations, design and construction engineers have adopted and implemented new safety standards that consider maintenance needs. It is imperative that all responsible agencies continue to recognize the implications of snow and ice control and other maintenance problems on a year around basis and take appropriate actions to rectify them in the planning, design and construction process.

It is concluded that maintenance functions provide driving safety to the motoring public by implementing and maintaining design standards in accordance with adopted policies. These functions are the only provisions furnished the roadway users until such time as complete reconstruction to incorporate the latest design features can be accomplished. To maximize driving safety a continuing effort must be placed to uniformly maintain roadways in accordance with adopted policies.

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SNOWY AND ICY STUDY AREAS
ESTIMATED AVERAGE DAILY TRAFFIC

Route	Milepost	Estimated ADT For				
		Year	Dec.	Jan.	Feb.	Mar.
I-15	120-130	1976	4650			
		1977	5390	4110	5510	5480
		1978	4810	4840	4990	5830
		1979	5170	4567	5010	5810
I-90	0-1	1976	2300			
		1977	2770	2570	2750	3090
		1978	2630	2160	2410	3060
		1979	2290	1840	2080	2570
I-90	21-44	1976	2230			
		1977	2320	2150	2300	2590
		1978	2650	2170	2430	3090
		1979	3150	2530	2870	3540
I-90	80-90	1976	2990			
		1977	2820	2610	2800	3150
		1978	3230	2650	2960	3760
		1979	3240	2600	2950	3640
I-90	96-110	1976	5590			
		1977	5160	4370	5630	5910
		1978	5900	5140	5680	6920
		1979	5620	5190	5970	7110
I-90	130-153	1976	3420			
		1977	2680	2460	2920	3070
		1978	3171	2760	3060	3720
		1979	3630	3350	3860	4590
I-90	170-185	1976	3520			
		1977	3270	3000	3570	3750
		1978	3200	2790	3090	3760
		1979	2880	2660	3060	3650
I-90	229-242	1976	2900			
		1977	3270	2490	3040	3320
		1978	2920	2930	3020	3535
		1979	3050	2690	2950	3430

Route	Milepost	Estimated ADT For				
		Year	Dec.	Jan.	Feb.	Mar.
I-90	298-311	1976	3990			
		1977	4280	3590	4380	4610
		1978	3790	3420	3980	4870
		1979	5290	4170	4950	6080
I-90	311-330	1976	3730			
		1977	4010	3370	4110	4330
		1978	3550	3210	3730	4570
		1979	4820	3800	5410	5540
I-90	330-340	1976	3150			
		1977	3110	2610	3180	3360
		1978	2740	2470	2880	3520
		1979	3570	3330	3960	4600
I-90	369-391	1976	2950			
		1977	2650	2220	2710	2860
		1978	2630	2380	2760	3380
		1979	3480	2740	3260	4000
I-90	429-445	1976	7330			
		1977	7230	6290	7110	6960
		1978	7870	6740	7050	8000
		1979	7670	7120	7390	8530
P-01	138-153	1976	2010			
		1977	1630	1630	2070	2160
		1978	1600	1470	1830	2550
		1979	3080	2160	2030	2710
P-01	209-222	1976	850			
		1977	720	720	910	950
		1978	730	670	830	1160
		1979	900	630	590	790
P-05	0-15	1976	3170			
		1977	2640	2470	3060	3030
		1978	2770	2510	2830	3360
		1979	2970	2390	2900	3520
P-24	0-32	1976	1390			
		1977	1450	1360	1510	1550
		1978	1630	1480	1600	1750
		1979	1740	1440	1550	1750
P-50	47-81	1976	1530			
		1977	910	930	1060	960
		1978	940	980	1070	1360
		1979	1120	930	1070	1170

<u>Route</u>	<u>Milepost</u>	<u>Estimated ADT For</u>				
		<u>Year</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>
P-86	0-19	1976	980			
		1977	1350	1380	1580	1440
		1978	1110	1150	1270	1600
		1979	1380	1150	1310	1430

Columbia Falls - Northeast
US #2 (FAP 1)
Milepost 140-150
Kalispell Division

General: Federal Aid Primary Road, built in the 1930's. Paved width varies from 20' to 24'. The roadway traverses the Flathead River with numerous curves and connects several small towns within the study area.

Comments: The Roadway is currently in the planning stage for 4-lane reconstruction. Contract letting has been curtailed pending court action.

Minor safety features have been placed at three locations where higher than normal accident frequency has occurred. The South Fork River Bridge and adjacent curve has been provided special chevron delineation.

Special side of the road delineation (x-1-1 Hazard Markers) was placed on a series of curves near Martin City.

A safety project to flatten inslopes and delineate a curve was completed at milepost 147.7 - 148.3. The curve is locally known as the "Dew Drop Curves."

ACCIDENT CLUSTER DETAILS
FAP 1 MP 140 - MP 150

SITE # 1

6 Accidents total
0% Eastbound
17% Icy or Snowy
50% Dark

SITE # 2

5 Accidents total
40% Eastbound
60% Icy or Snowy
80% Dark

SITE # 5

5 Accidents total
40% Eastbound
20% Icy or Snowy
20% Dark

SITE # 3

11 Accidents total
27% Eastbound
36% Icy or Snowy
64% Dark

SITE # 6

6 Accidents total
33% Eastbound
50% Icy or Snowy
67% Dark

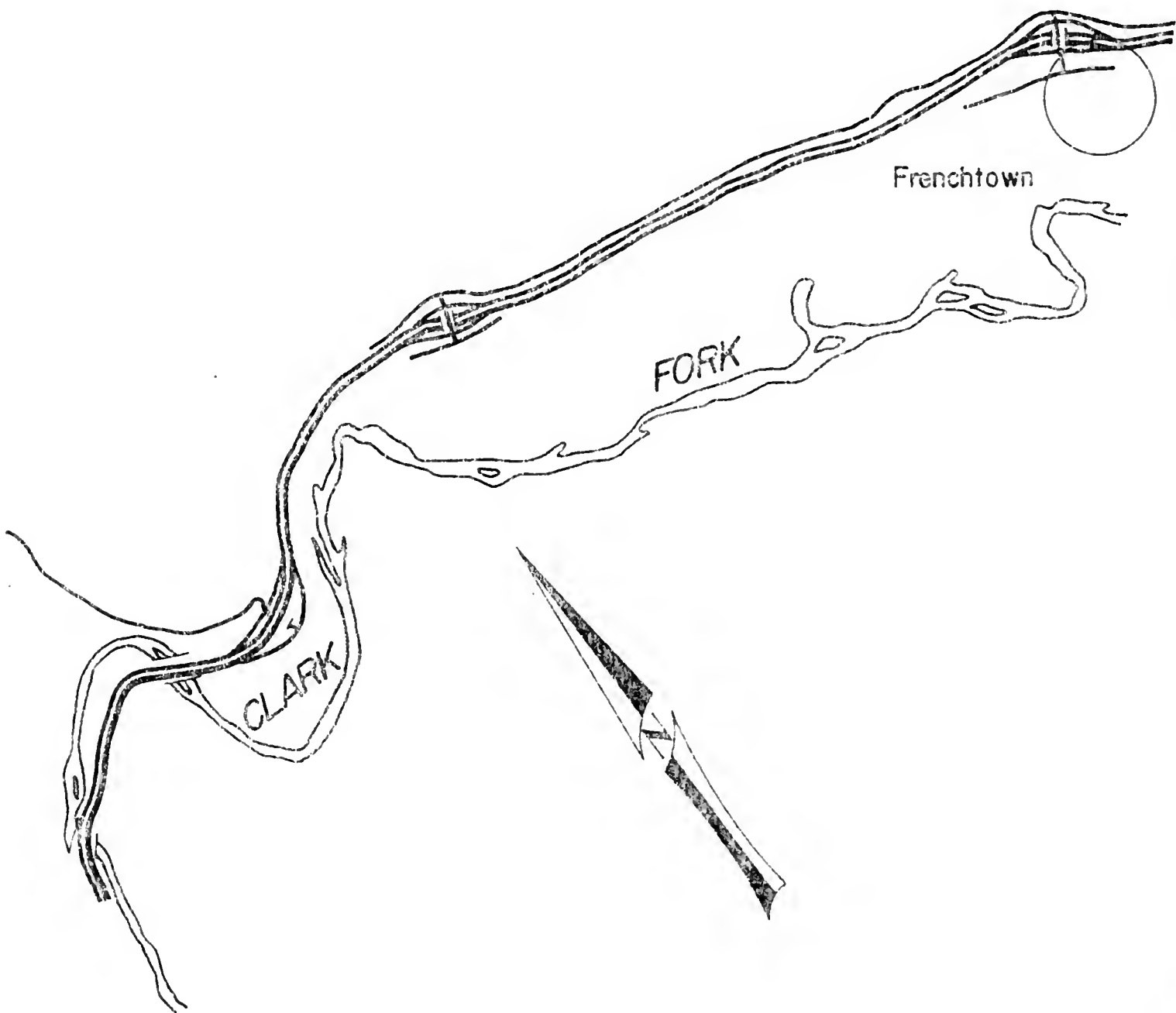
SITE # 4

5 Accidents total
100% Eastbound
0% Icy or Snowy
80% Dark

Frenchtown - West
Interstate 90
Milepost 80 - 90
Missoula Division

General: The Study area is a 4-lane section with concrete driving lanes and asphalt shoulders. At Milepost 80 - 82 a recently completed add two lanes project was opened to the driving public in 1979. The section traverses fairly level terrain.

Comment: Accident experience for this section was misplaced, therefore is not reflected on the adjoining map. A clustering of accidents has occurred at approximately Milepost 82 on a verticle curve. A clustering of accidents has also occurred on a curve section at Milepost 88.5⁺ and at the Frenchtown Interchange at Milepost 89.5⁺.



I 90

MILEPOST 80 - MILEPOST 90

Missoula East and West
Interstate 90
Milepost 100 - 110
Missoula Division

General: This study area extends through the city of Missoula. Numerous interchanges and high traffic volumes are present. The roadway was constructed in 1966 with the driving surface PCC Concrete.

Comments: Accident frequency is scattered throughout the section with a buildup at or near the interchanges.

ACCIDENT CLUSTER DETAIL
I 90 MP 100 - MP 110

SITE # 1

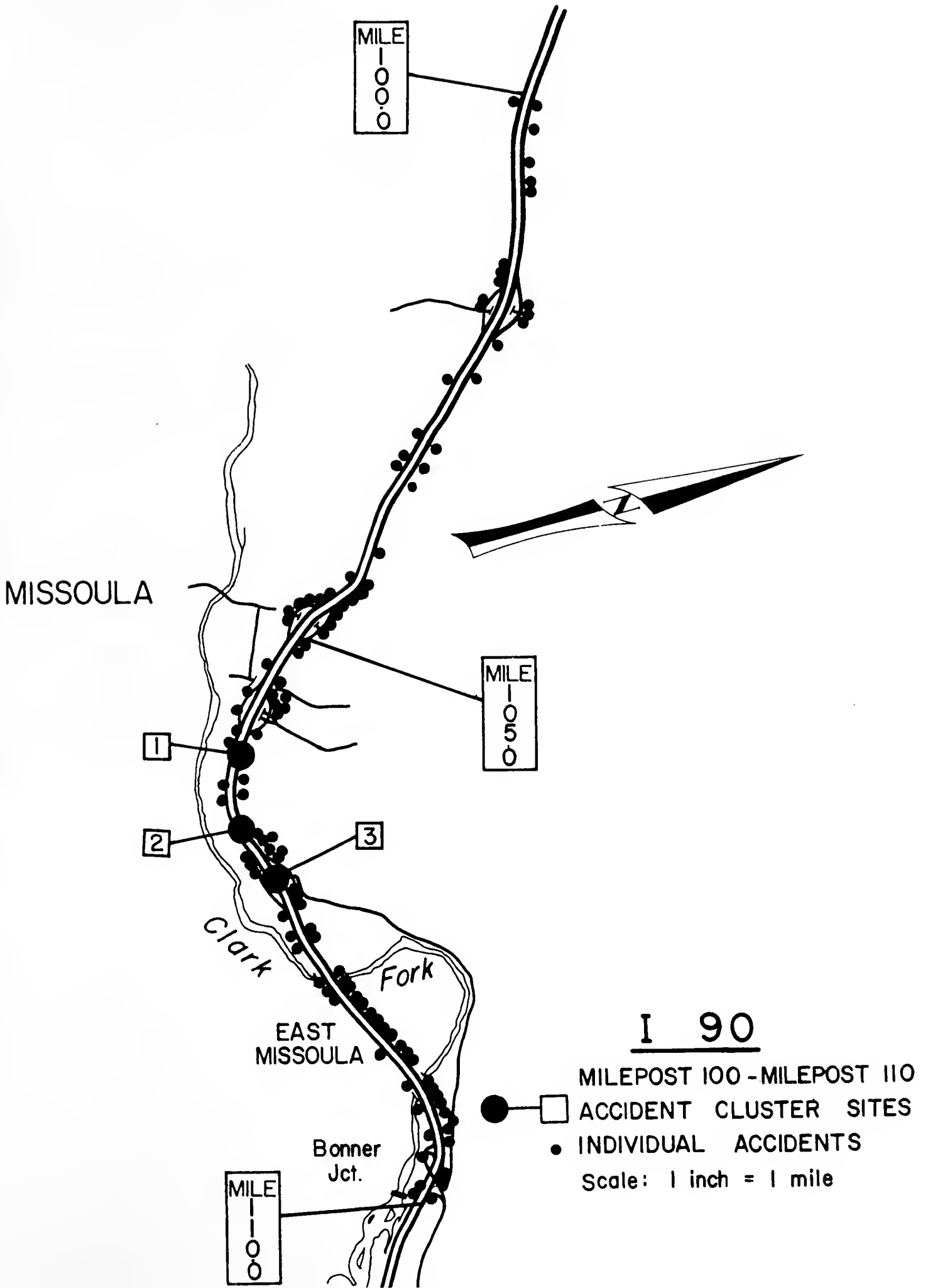
7 Accidents total
57% Eastbound
71% Icy or Snowy
57% Dark

SITE # 2

10 Accidents total
10% Eastbound
90% Icy or Snowy
10% Dark

SITE # 3

12 Accidents total
50% Eastbound
8% Icy or Snowy
50% Dark



Missoula - Drummond
Interstate 90
Milepost 130 - 140
140 - 150
Missoula Division

- General: This study section contains two 10-mile contiguous sections. Various construction years to complete the four-lane facility took place. The entire 20-mile section has a plant mix surface treatment.
- Comment: Accident frequency is spread throughout the study area. Several clusters of accidents were noted primarily on curve sections and at bridges. A safety project at Milepost 145+ entailed concrete median barrier and was near the Bearmouth Rest Area. A nearby hot water spring instigated foggy and icing conditions. This improvement has substantially reduced accident frequency and severity at this location.

ACCIDENT CLUSTER DETAIL
I 90 MP 130 - MP 150

SITE # 1

10 Accidents total
70% Eastbound
90% Icy or Snowy
50% Dark

SITE # 2

9 Accidents total
67% Eastbound
78% Icy or Snowy
22% Dark

SITE # 5

8 Accidents total
63% Eastbound
88% Ecy or Snowy
0% Dark

SITE # 3

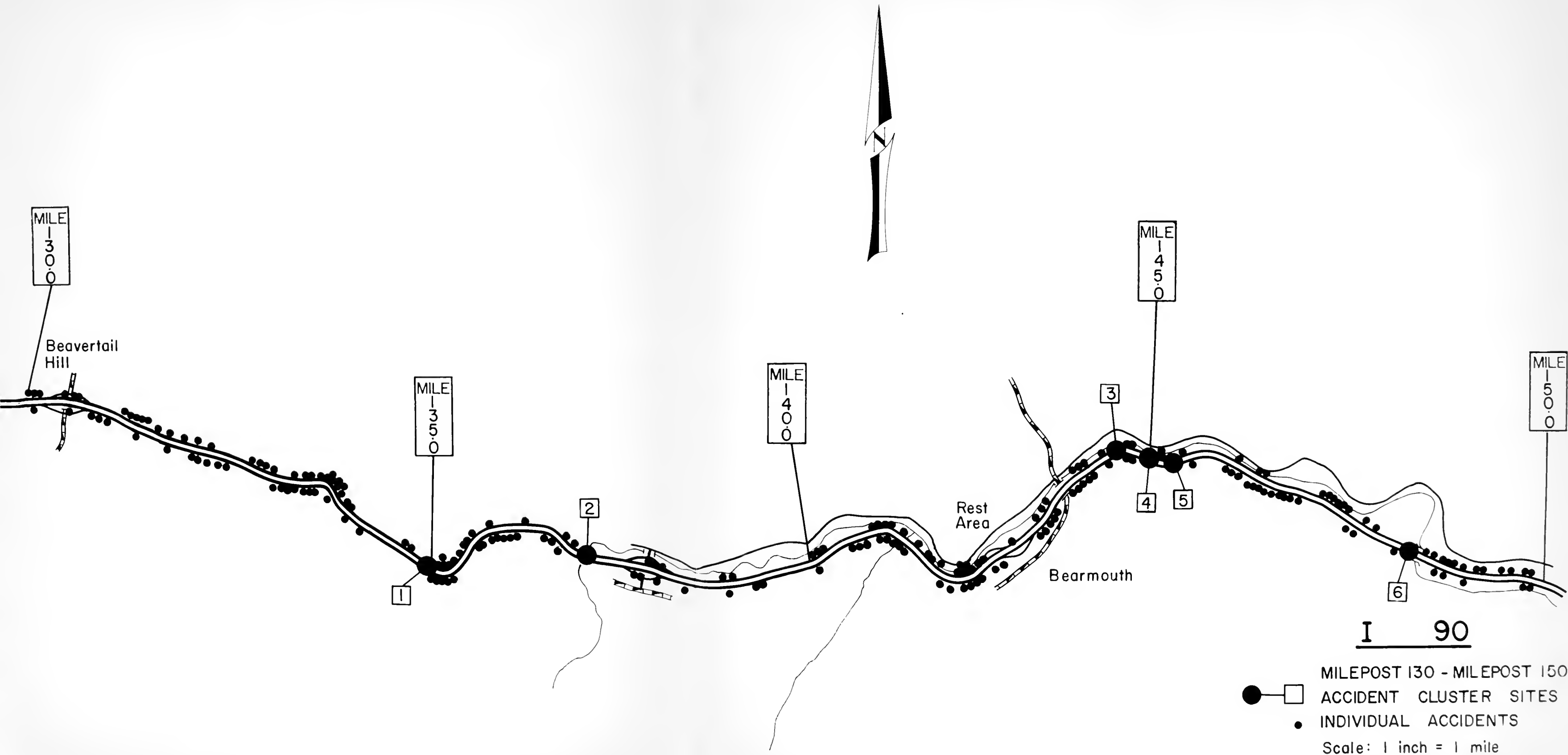
12 Accidents total
100% Eastbound
83% Icy or Snowy
17% Dark

SITE # 6

10 Accidents total
20% Eastbound
70% Icy or Snowy
30% Dark

SITE # 4

12 Accidents total
50% Eastbound
58% Icy or Snowy
33% Dark



Missoula - North
US #93 (FAP 5)
Milepost 0 - 10
Missoula Division

General: The area begins on US #93 at its junction with I-90 at the DeSmitt Interchange and proceeds north for 10 miles. Numerous safety projects have been constructed on this section including roadway widening at the truck stop and slope flattening and delineation on some curves.

Comments: A safety project to provide slope flattening and delineation on a curve approximately Milepost 2, is tentatively scheduled for letting of January 1981.

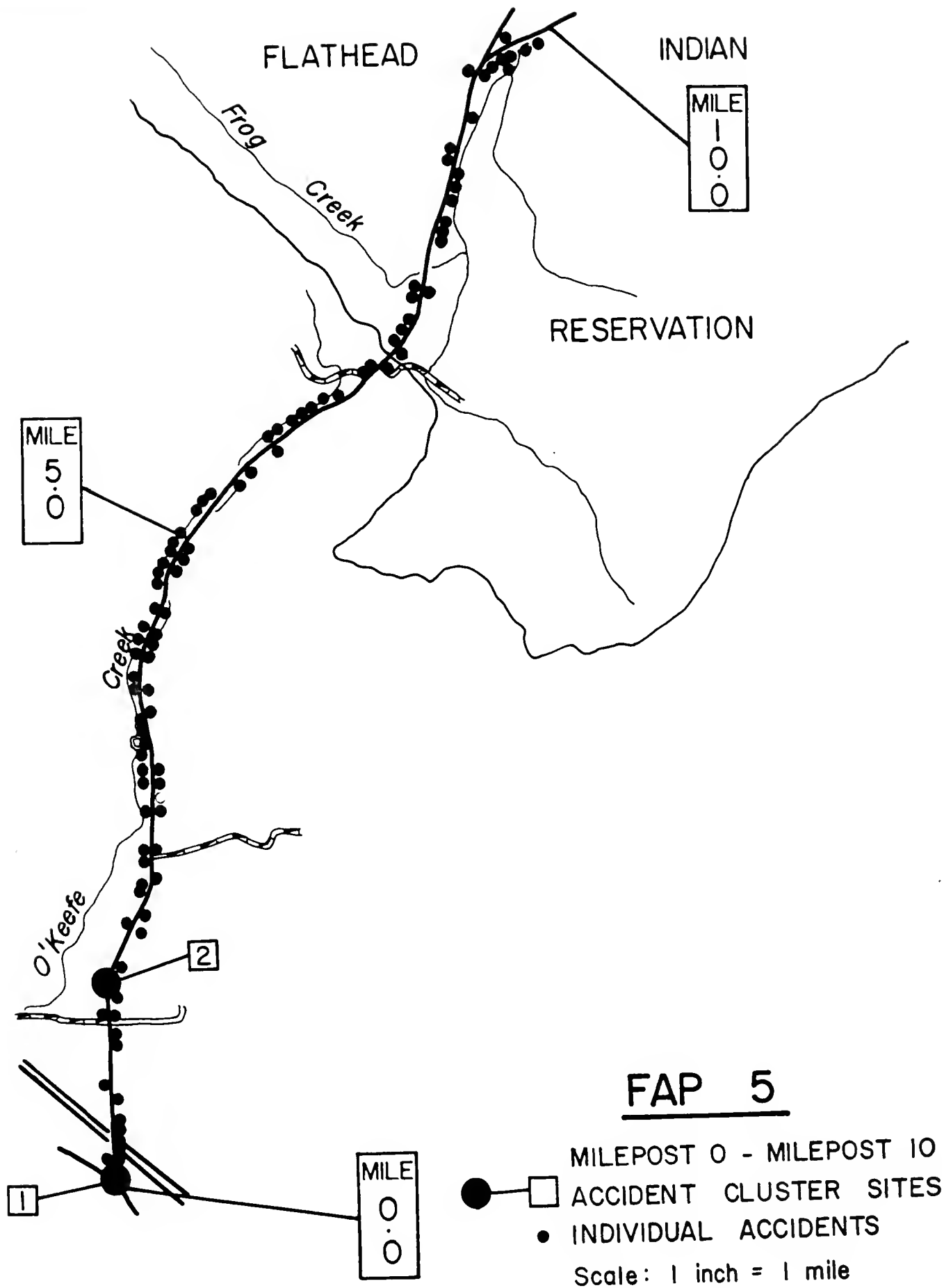
ACCIDENT CLUSTER DETAIL
FAP 5 MP 0 - MP 10

SITE # 1

7 Accidents total
43% Northbound
29% Icy or Snowy
29% Dark

SITE # 2

5 Accidents total
20% Northbound
20% Icy or Snowy
40% Dark



Bonner - East
Montana 200 (FAP 24)
Milepost 0 - 10
Missoula Division

General: The section begins near the Interstate 90 Bonner Interchange at Bonner and traverses the Blackfoot River East. Construction periods vary through the section. The beginning portion was constructed or altered to provide interstate connections. The easterly portion is basically old road with numerous curves.

Comment: Accident history is concentrated at the beginning of the route and at a curve section commonly known as Rainbow Bend. A safety project is in the planning stage for this area. Also special side of the road delineation was placed in this area to provide positive guidance around the sharp curves.

ACCIDENT CLUSTER DETAIL
P 24 MP 0 - MP 10

SITE # 1

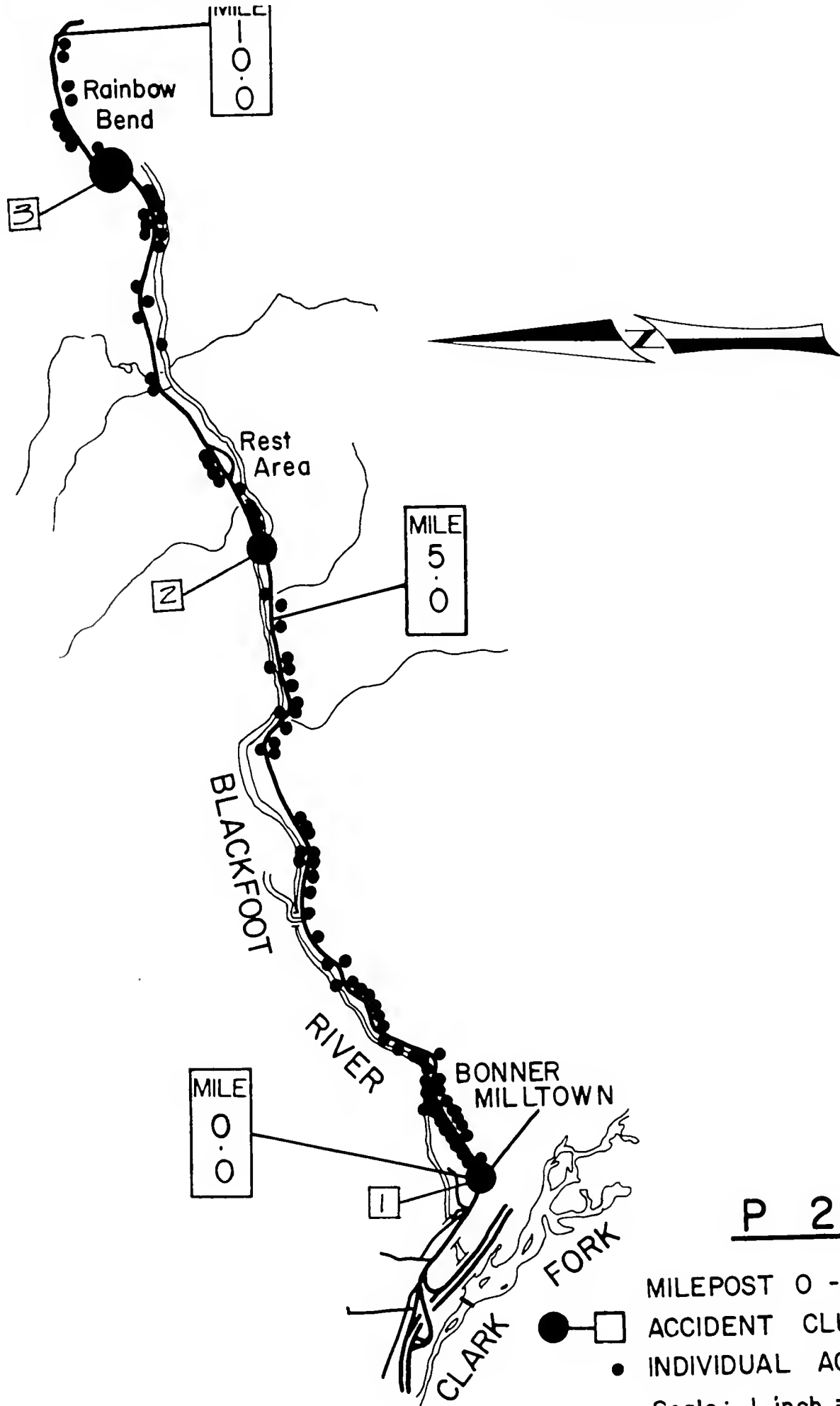
12 Accidents total
50% Eastbound
33% Icy or Snowy
33% Dark

SITE # 2

5 Accidents total
40% Eastbound
40% Icy or Snowy
20% Dark

SITE # 3

21 Accidents total
43% Eastbound
14% Icy or Snowy
24% Dark



P 24

MILEPOST 0 - MILEPOST 10
● ACCIDENT CLUSTER SITES
• INDIVIDUAL ACCIDENTS
Scale: 1 inch = 1 mile

Belgrade - Bozeman
Interstate 90
Milepost 300 - 310
Bozeman Division

General: The 4-lane facility, built in the late 60's - mid early 70's has a plant mix surface treatment with a V-ditch median on the majority of the section. Concrete driving lanes with asphalt shoulders are present at the beginning of the study section.

Comment: Accident occurrence is spread throughout the study area with clusters of accidents occurring at the West Bozeman Interchange and East of Bozeman on a curve section.

ACCIDENT CLUSTER DETAIL

I 90 MP 300 - MP 310

SITE # 1

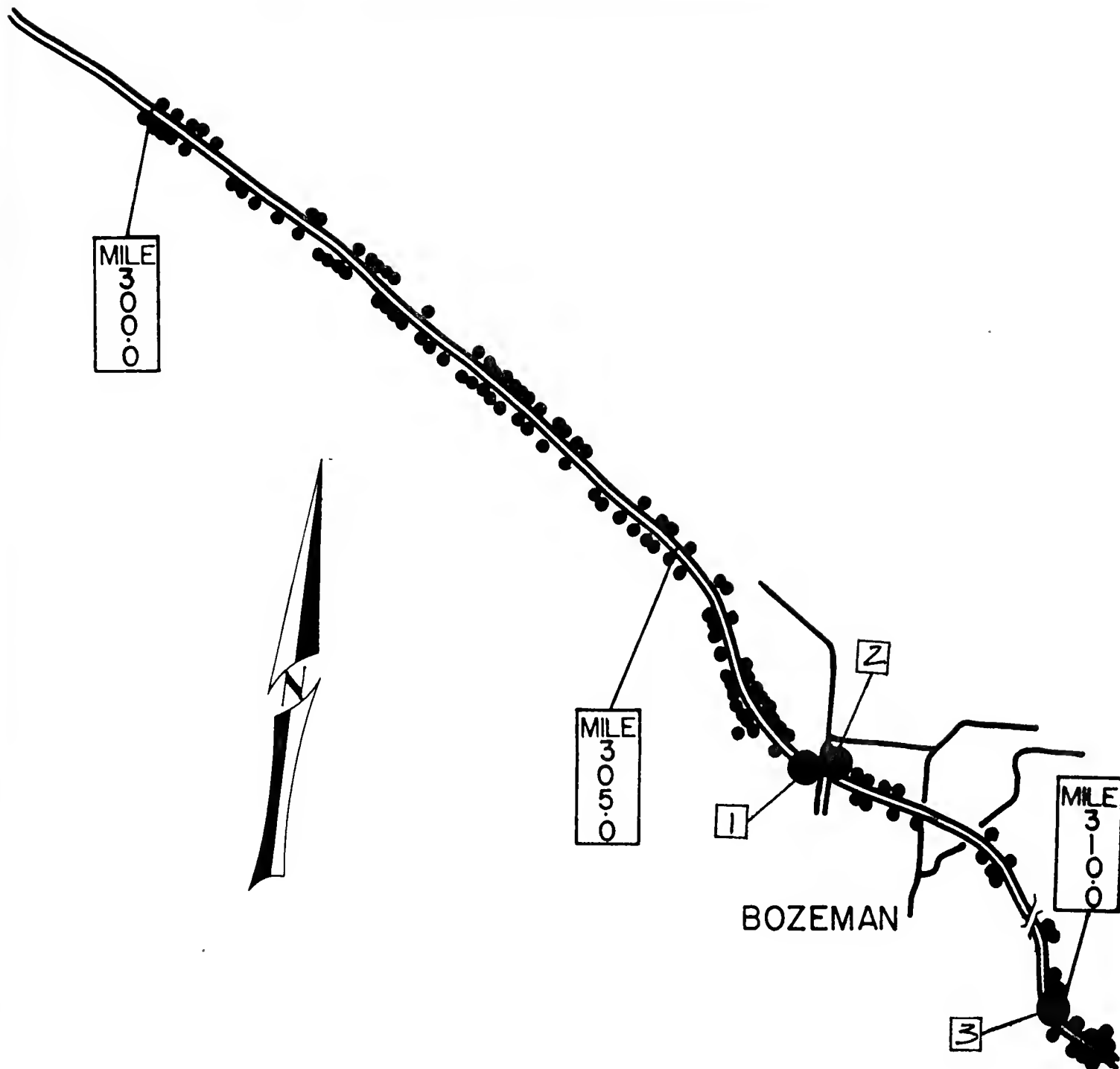
11 Accidents total
82% Eastbound
55% Icy or Snowy
9% Dark

SITE # 2

15 Accidents total
0% Eastbound
53% Ecy or Snowy
40% Dark

SITE # 3

12 Accidents total
58% Eastbound
67% Icy or Snowy
42% Dark



I - 90

- — □ MILEPOST 300 - MILEPOST 310
● ACCIDENT CLUSTER SITES
● INDIVIDUAL ACCIDENTS

Scale: 1 inch = 1 mile

Bozeman - Livingston
Interstate 90
Milepost 310 - 320
320 - 330
330 - 340
Bozeman Division

General: This area includes three study areas contiguously and begins on the East urban limits of Bozeman traverses Bozeman Pass and ends near the Mission Interchange East of Livingston. The area at particular locations experience very high wind velocity causing limited visibility and snowdrifting during winter months.

Comment: A high incidence of accident occurrence has happened with numerous clusters on the west slope of Bozeman Pass to Bozeman. Several clusters of accident also exists in the Livingston area. A Wyoming type snowfence was installed, utilizing safety funds, at various locations near Livingstone.

ACCIDENT CLUSTER DETAILS
I-90 MP 310 - MP 340

SITE # 1
12 Accidents total
53% Eastbound
66% Icy or Snowy
58% Dark

SITE # 8
6 Accidents total
100% Eastbound
100% Icy or Snowy
17% Dark

SITE # 2
17 Accidents total
28% Eastbound
76% Icy or Snowy
41% Dark

SITE # 9
10 Accidents total
50% Eastbound
90% Icy or Snowy
30% Dark

SITE # 3
8 Accidents total
12% Eastbound
62% Icy or Snowy
37% Dark

SITE # 10
10 Accidents total
50% Eastbound
30% Icy or Snowy
20% Dark

SITE # 4
5 Accidents total
0% Eastbound
100% Icy or Snowy
40% Dark

SITE # 11
9 Accidents total
44% Eastbound
56% Icy or Snowy
67% Dark

SITE # 5
21 Accidents total
57% Eastbound
71% Icy or Snowy
19% Dark

SITE # 12
9 Accidents total
56% Eastbound
56% Icy or Snowy
11% Dark

SITE # 6
8 Accidents total
25% Eastbound
100% Icy or Snowy
13% Dark

SITE # 13
25 Accidents total
52% Eastbound
40% Icy or Snowy
24% Dark

SITE # 7
24 Accidents total
67% Eastbound
79% Icy or Snowy
25% Dark

SITE # 14
8 Accidents total
88% Eastbound
63% Icy or Snowy
38% Dark

ACCIDENT CLUSTER DETAILS

I-90 MP 310 - MP 340
(continued)

SITE # 15

7 Accidents total
29% Eastbound
57% Icy or Snowy
29% Dark

SITE # 16

6 Accidents total
67% Eastbound
83% Icy or Snowy
0% Dark

SITE # 21

10 Accidents total
50% Eastbound
70% Icy or Snowy
30% Dark

SITE # 17

12 Accidents total
50% Eastbound
58% Icy or Snowy
25% Dark

SITE # 22

6 Accidents total
67% Eastbound
50% Icy or Snowy
17% Dark

SITE # 18

6 Accidents total
17% Eastbound
17% Icy or Snowy
50% Dark

SITE # 23

7 Accidents total
29% Eastbound
100% Icy or Snowy
0% Dark

SITE # 19

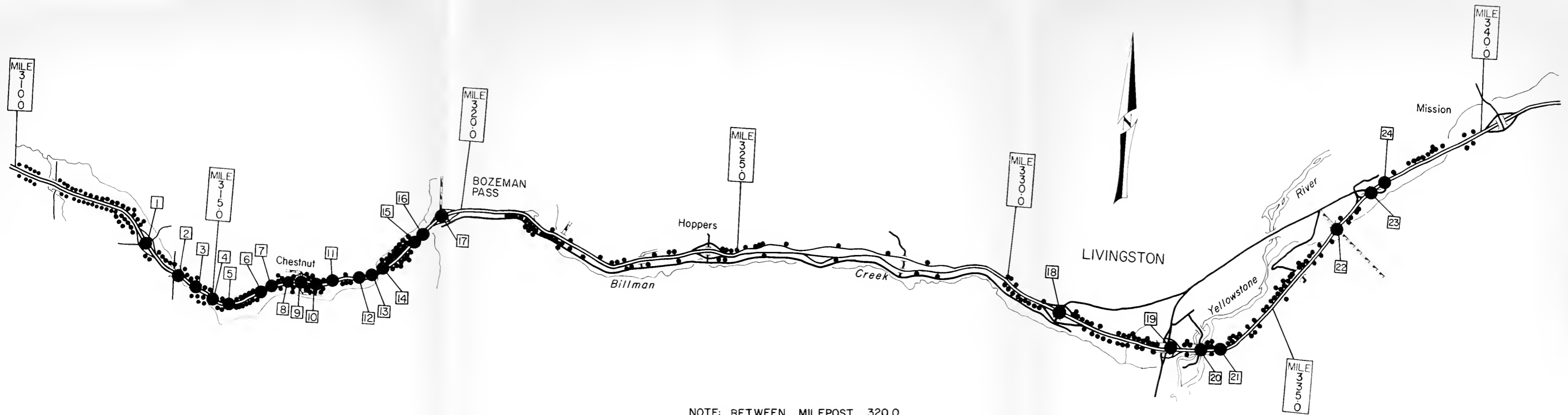
12 Accidents total
67% Eastbound
33% Icy or Snowy
8% Dark

SITE # 24

7 Accidents total
100% Eastbound
29% Icy or Snowy
57% Dark

SITE # 20

14 Accidents total
14% Eastbound
43% Icy or Snowy
57% Dark



NOTE: BETWEEN MILEPOST 320.0
AND MILEPOST 330.0 IT
IS NEW CONSTRUCTION. ONLY
2 YEARS DATA.

I 90

- MILEPOST 310 - MILEPOST 340
- ACCIDENT CLUSTER SITES
- INDIVIDUAL ACCIDENTS
- Scale: 1 inch = 1 mile

Bozeman (Gallatin Canyon)
US #191 (FAP 50)
Milepost 50 - 60
60 - 70
Bozeman Division

General: This Federal Aid Primary System Roadway parallels the Gallatin River between Yellowstone Park and Bozeman. This scenic highway experiences high volume tourist traffic entering Yellowstone National Park. The roadway, built in the 50's and 60's traverses heavily timbered mountainous terrain.

Comment: Accident experience is spread throughout the study area with numerous clusters of accidents generally located on curve sections. A safety project to install safety corrections such as guardrail roadway widening and an impact attenuator was installed in 1978 between Milepost 56 - 63. The safety corrections have not impeded snow removal. Accident experience shows a definite reduction after installation of the safety corrections. Special side of the road delineation at Milepost 50₊ - 51₊ installed on an experimental basis has shown a definite reduction in accidents.

ACCIDENT CLUSTER DETAILS
FAP 50 MP 50 - MP 70

SITE # 1

17 Accidents total
100% Northbound
29% Icy or Snowy
18% Dark

SITE # 2

10 Accidents total
100% Northbound
60% Icy or Snowy
80% Dark

SITE # 3

10 Accidents total
90% Northbound
40% Icy or Snowy
50% Dark

SITE # 4

25 Accidents total
64% Northbound
80% Icy or Snowy
60% Dark

SITE # 5

5 Accidents total
60% Northbound
80% Icy or Snowy
40% Dark

SITE # 6

13 Accidents total
46% Northbound
46% Icy or Snowy
54% Dark

SITE # 7

14 Accidents total
43% Northbound
64% Icy or Snowy
57% Dark

SITE # 8

7 Accidents total
86% Northbound
43% Icy or Snowy
43% Dark

SITE # 9

7 Accidents total
43% Northbound
57% Icy or Snowy
23% Dark

SITE # 10

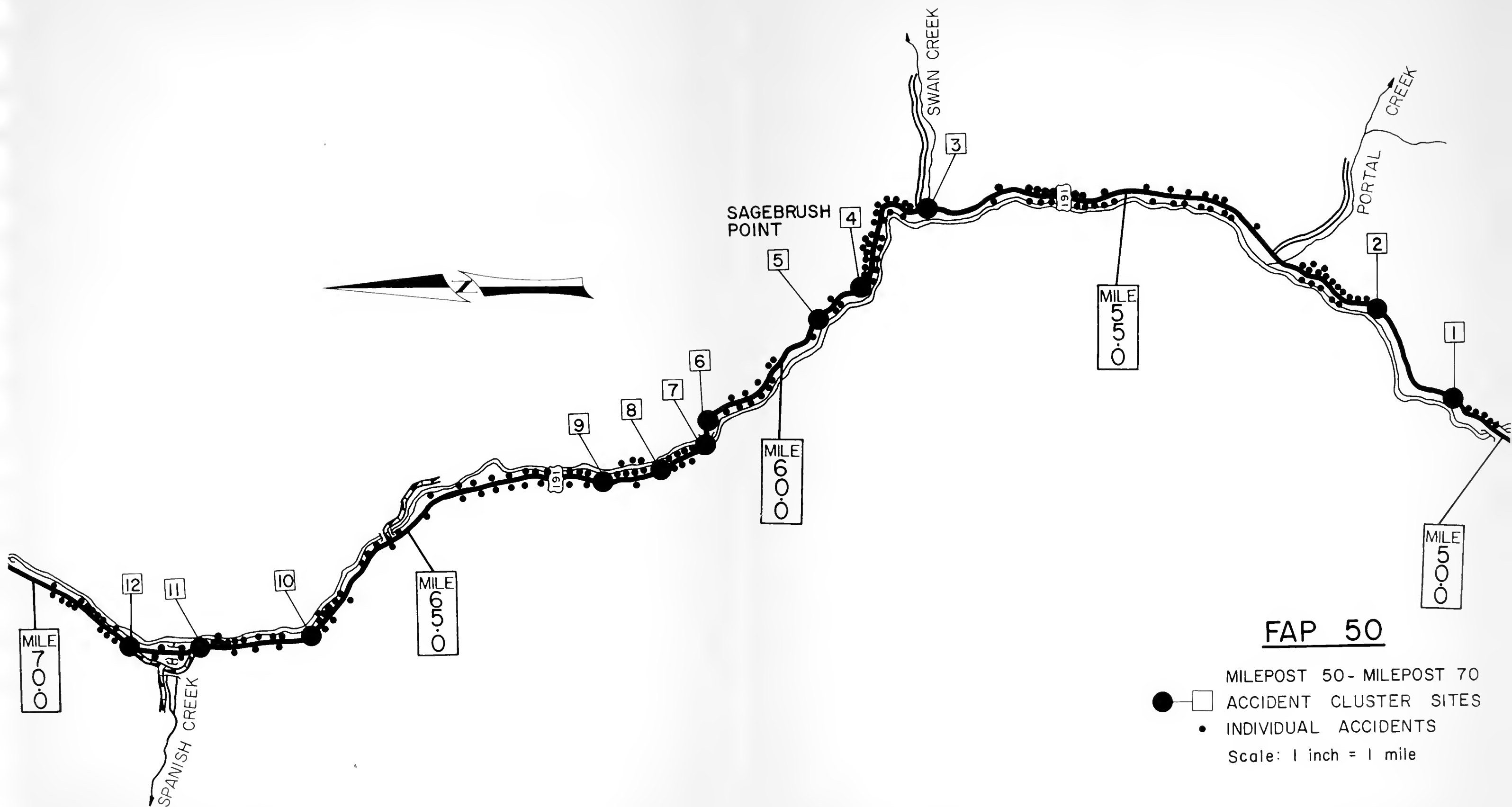
6 Accidents total
67% Northbound
67% Icy or Snowy
17% Dark

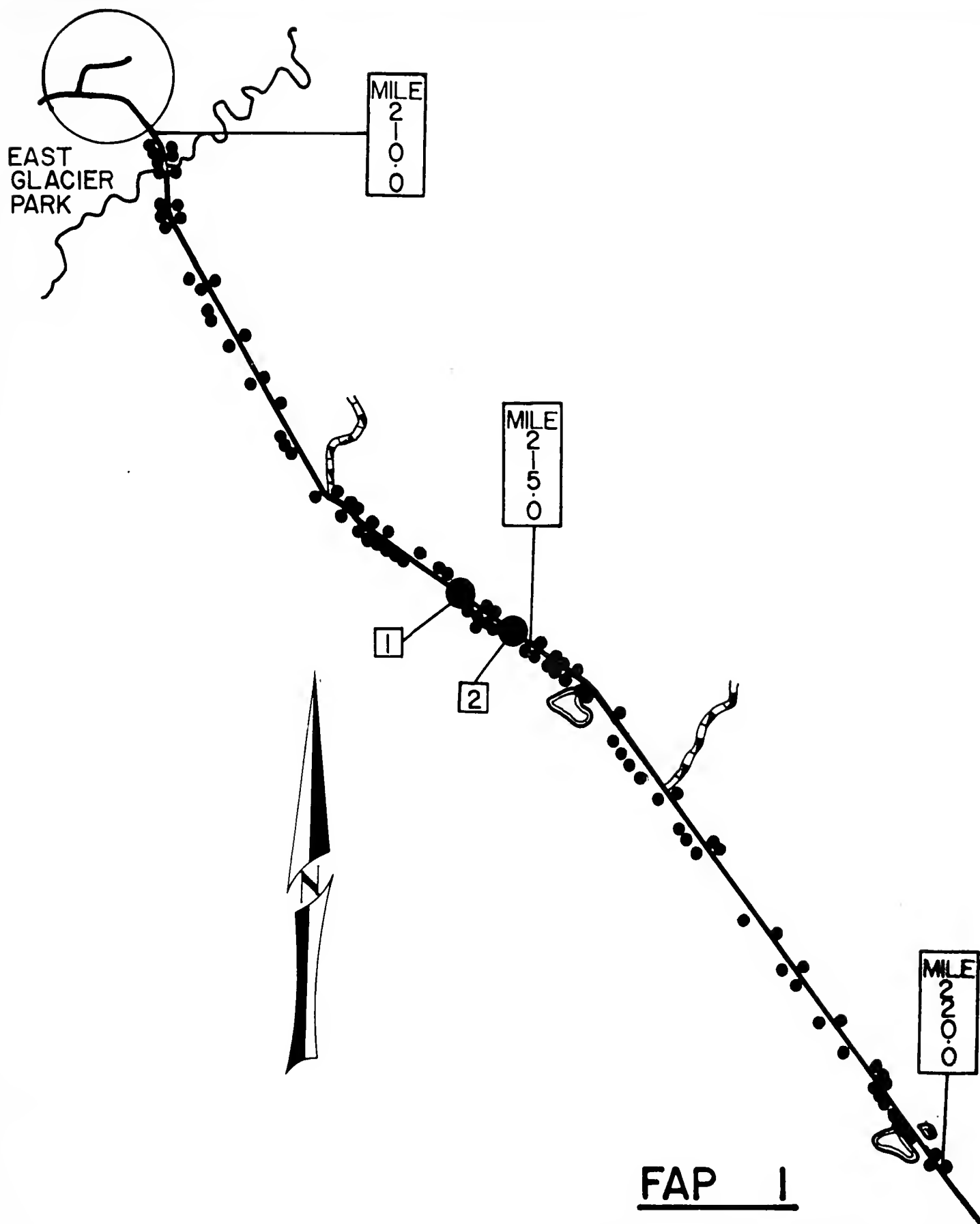
SITE # 11

10 Accidents total
70% Northbound
50% Icy or Snowy
30% Dark

SITE # 12

10 Accidents total
50% Northbound
50% Icy or Snowy
60% Dark





MILEPOST 210 - MILEPOST 220

● ACCIDENT CLUSTER SITES

• INDIVIDUAL ACCIDENTS

Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAIL
FAP 1 MP 210 - MP 220

SITE # 1

10 Accidents total

40% Eastbound

70% Icy or Snowy

20% Dark

SITE # 2

8 Accidents total

50% Eastbound

88% Icy or Snowy

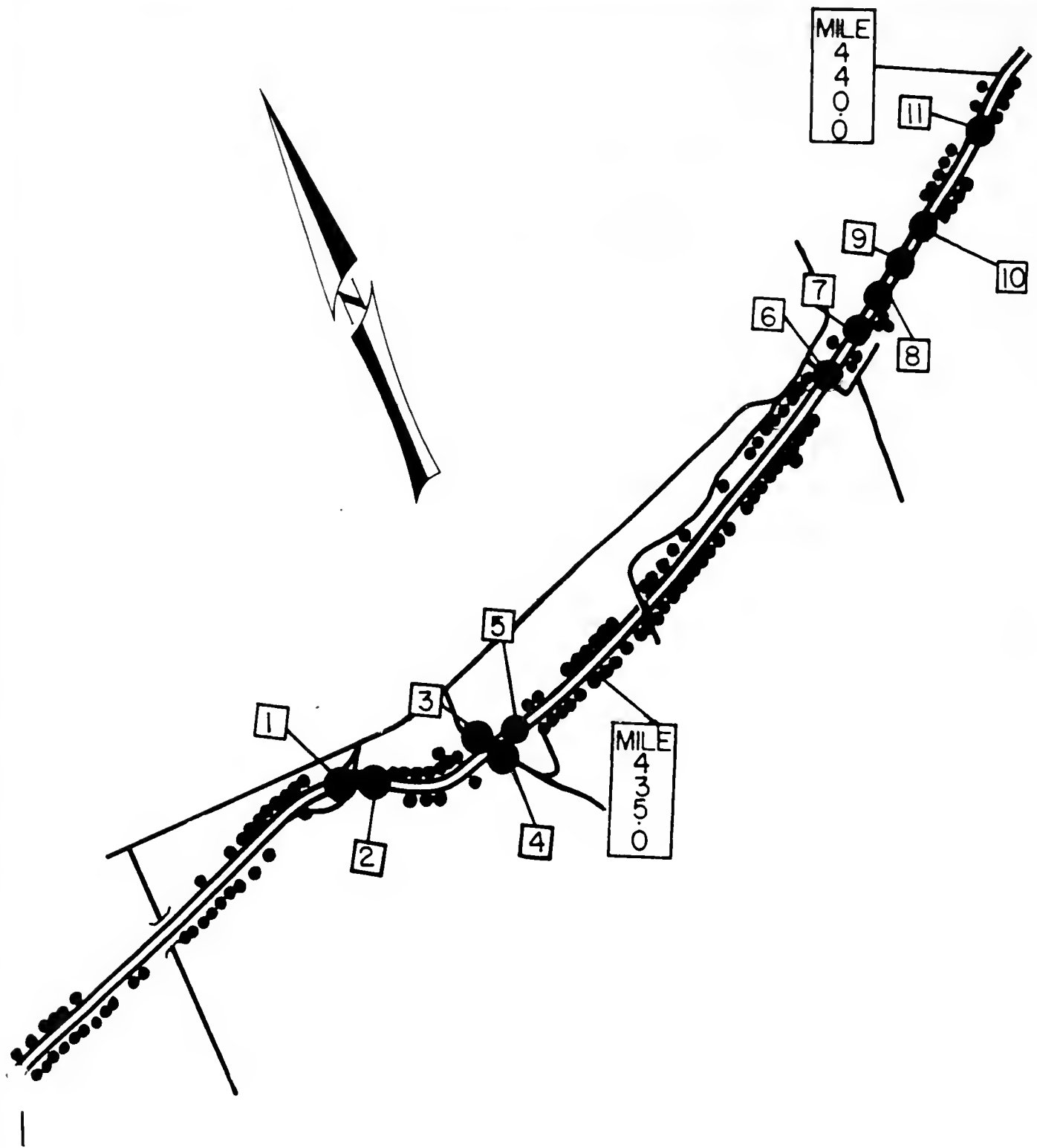
13% Dark

East Glacier - Northeast
US #2 (FAP 1)
Milepost 210 - 220
Havre Division

General: The study area is a two-lane F.A. Primary Roadway with three construction sections within the area. The majority of the section was built in 1977. The west end, approximately two miles, was constructed in the 1940's and the east end of the study area, approximately one mile, was constructed in the 1940's.

Comment: Accident history is spread out through the study area. A reduction in accident occurrence is noted on the newer constructed section. A clustering of accidents has occurred on or near the Two Medicine Bridge east of East Glacier.

DM:dk:34D



1
MILE
0
1

I 90

- — □ ACCIDENT CLUSTER SITES
- INDIVIDUAL ACCIDENTS

Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAIL
I-90 MP 430 - MP 440

SITE # 1

18 Accidents
72% Eastbound
39% Icy or Snowy
50% Dark

SITE # 7

9 Accidents
33% Eastbound
33% Icy or Snowy
44% Dark

SITE # 2

11 Accidents
45% Eastbound
73% Icy or Snowy
36% Dark

SITE # 8

12 Accidents
42% Eastbound
8% Icy or Snowy
83% Dark

SITE # 3

22 Accidents
0% Eastbound
27% Icy or Snowy
15% Dark

SITE # 9

16 Accidents
69% Eastbound
50% Icy or Snowy
44% Dark

SITE # 4

12 Accidents
100% Eastbound
58% Icy or Snowy
25% Dark

SITE # 10

11 Accidents
55% Eastbound
18% Icy or Snowy
45% Dark

SITE # 5

9 Accidents
89% Eastbound
22% Icy or Snowy
44% Dark

SITE # 11

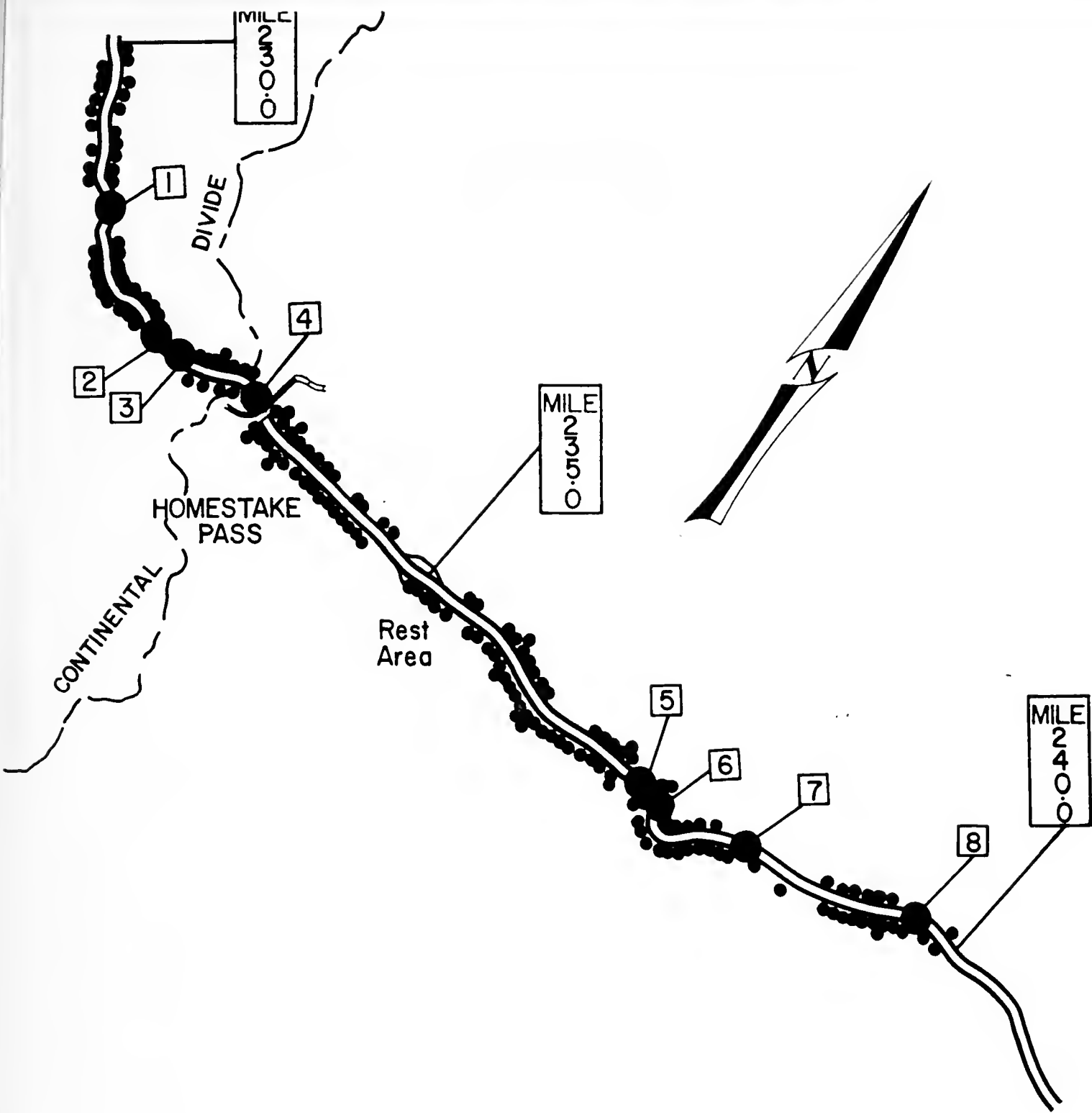
6 Accidents
17% Eastbound
50% Icy or Snowy
50% Dark

SITE # 6

16 Accidents
56% Eastbound
75% Icy or Snowy
50% Dark

Laurel East and West
Interstate 90
Milepost 430 - 440
Billings Division

- General: This Study area is a four-lane facility built in the 1960's and includes numerous interchanges. The roadway has a plant mix surface treatment and experiences high local traffic volumes.
- Comment: Accident experience is spread throughout the study section. Clusters of accidents have occurred in the interchange areas and on the tangent section near Milepost 438.



I 90

- MILEPOST 230 - MILEPOST 240
- ACCIDENT CLUSTER SITES
 - INDIVIDUAL ACCIDENTS
- Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAIL
I 90 MP 230 - MP 240

SITE # 1

9 Accidents total
56% Eastbound
67% Icy or Snowy
56% Dark

SITE # 2

8 Accidents total
25% Eastbound
100% Icy or Snowy
75% Dark

SITE # 3

18 Accidents total
39% Eastbound
67% Icy or Snowy
44% Dark

SITE # 4

12 Accidents total
58% Eastbound
75% Icy or Snowy
33% Dark

SITE # 5

12 Accidents total
83% Eastbound
83% Icy or Snowy
17% Dark

SITE # 6

14 Accidents total
79% Eastbound
71% Icy or Snowy
29% Dark

SITE # 7

8 Accidents total
63% Eastbound
100% Icy or Snowy
50% Dark

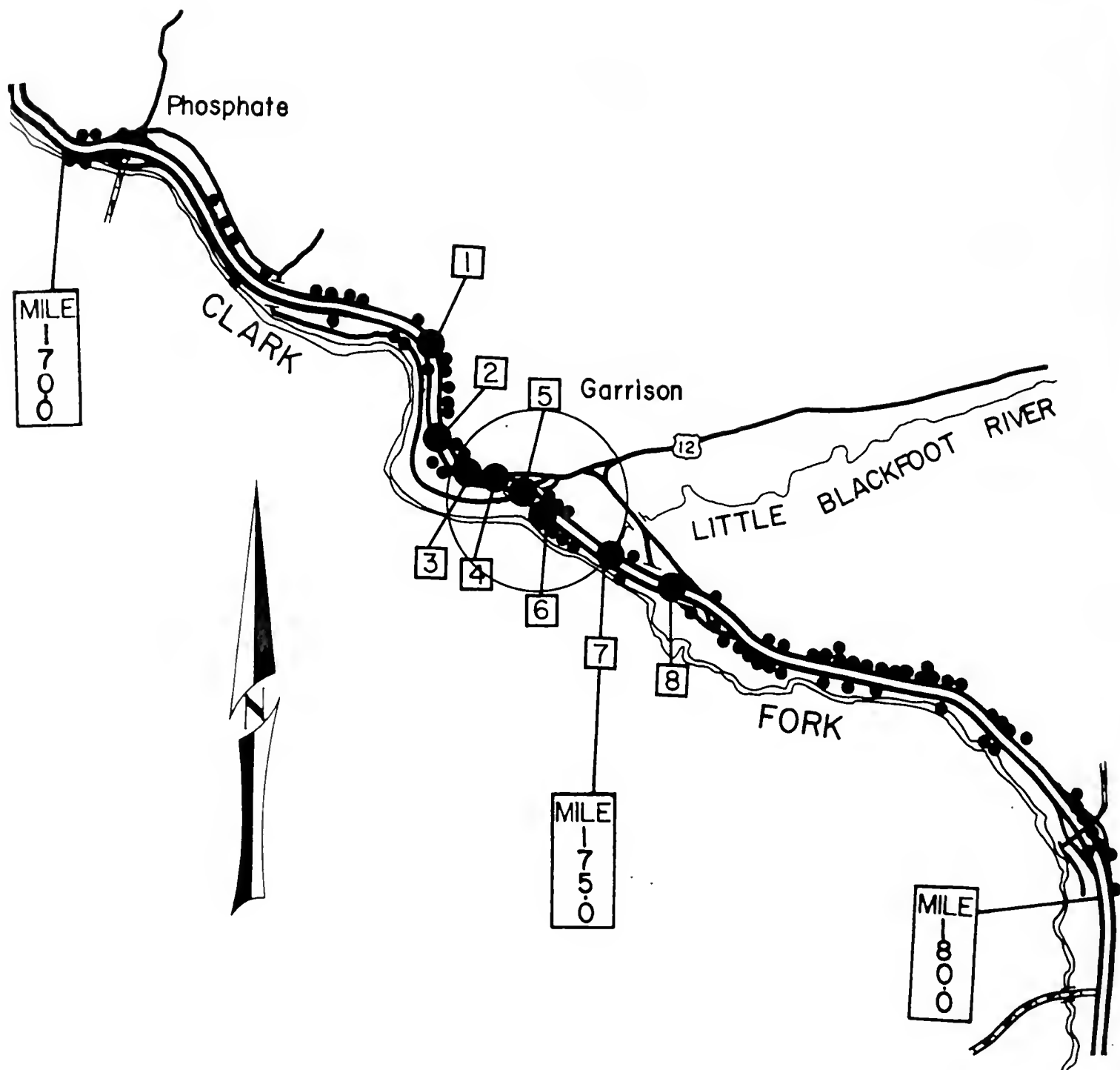
SITE # 8

14 Accidents total
79% Eastbound
14% Icy or Snowy
29% Dark

Butte - Whitehall (Homestake Pass)
Interstate 90
Milepost 230 - 240
Butte Division

General: This study section is a four-lane facility built in 1966 and has a plant mix surface treatment and crosses the Continental Divide at Homestake Pass. One interchange is affected, located on top of the pass.

Comment: Accident history is spread throughout the section. Several clusters of accidents are present particularly on horizontal curve sections and at the area of the interchange. Safety improvements, particularly directed for large trucks, has been placed on the east slope of Homestake Pass.



I 90

- MILEPOST 170 - MILEPOST 180
- — □ ACCIDENT CLUSTER SITES
 - INDIVIDUAL ACCIDENTS
- Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAILS
I - 90 MP 170 - MP 180

SITE # 1

6 Accidents total
67% Eastbound
17% Icy or Snowy
17% Dark

SITE # 2

6 Accidents total
33% Eastbound
33% Icy or Snowy
17% Dark

SITE # 6

9 Accidents total
67% Eastbound
44% Icy or Snowy
44% Dark

SITE # 3

17 Accidents total
53% Eastbound
41% Icy or Snowy
59% Dark

SITE # 7

26 Accidents total
4% Eastbound
38% Icy or Snowy
31% Dark

SITE # 4

19 Accidents total
42% Eastbound
16% Icy or Snowy
21% Dark

SITE # 8

7 Accidents total
57% Eastbound
57% Icy or Snowy
0% Dark

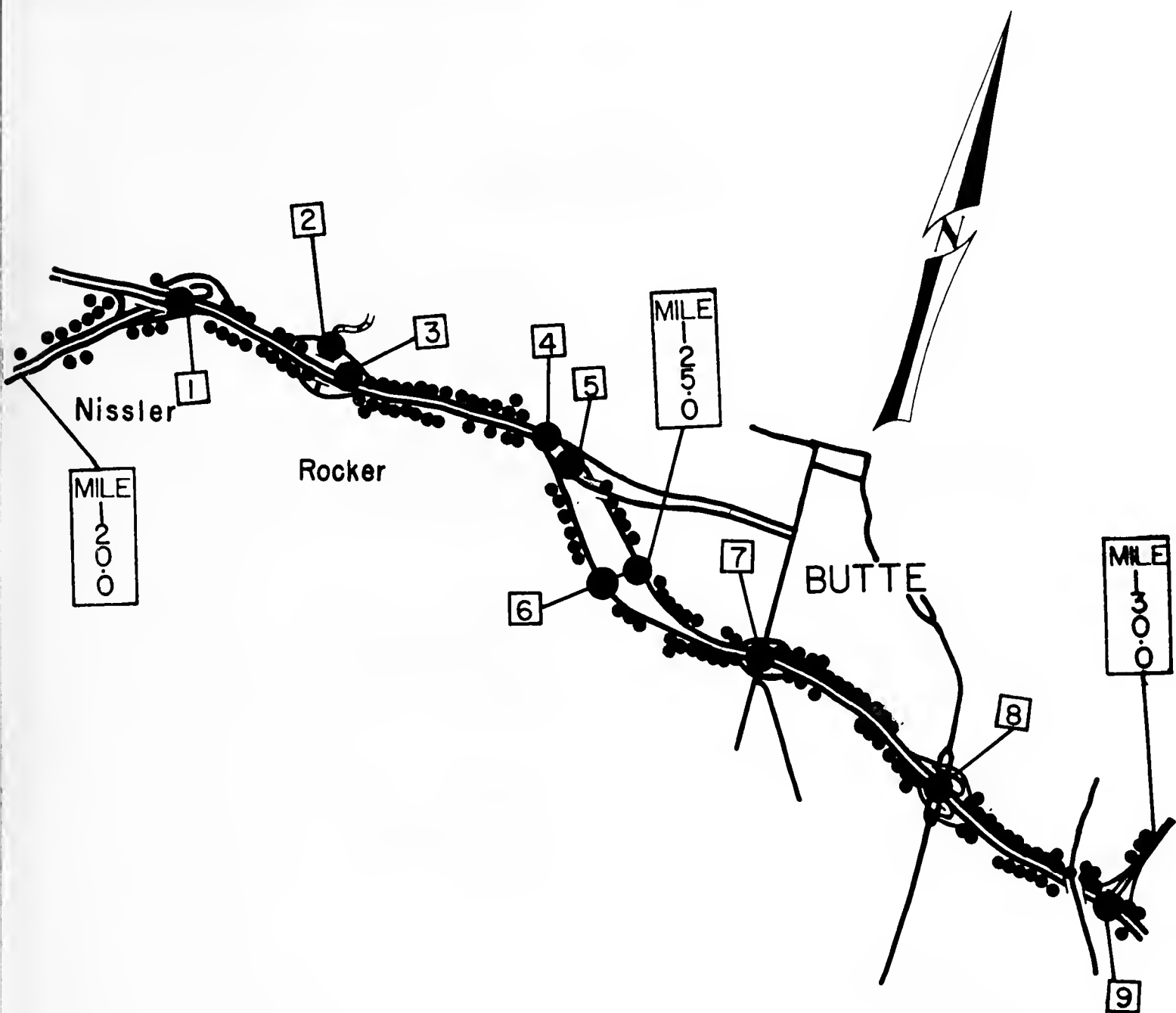
SITE # 5

16 Accidents total
25% Eastbound
31% Icy or Snowy
38% Dark

Garrison
Interstate 90
Milepost 170 - 180
Missoula and Butte Division

General: The majority of this study area was under construction at the time of the field review. The roadway section from Milepost 176+ was constructed in 1976.

Comment: Accident information shown on the accompanying map should be disregarded except for information shown from Milepost 176+ to 180. Accidents shown between 170 - 176+ reflect occurrence on the old traveled way.



I - 15

- MILEPOST 120 - MILEPOST 130
- — □ ACCIDENT CLUSTER SITES
 - INDIVIDUAL ACCIDENTS
- Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAILS

I 15 MP 120 - MP 130

SITE # 1

15 Accidents total
100% Northbound
13% Icy or Snowy
27% Dark

SITE # 6

18 Accidents total
50% Northbound
50% Icy or Snowy
56% Dark

SITE # 2

6 Accidents total
0% Northbound
33% Icy or Snowy
50% Dark

SITE # 7

11 Accidents total
45% Northbound
36% Icy or Snowy
45% Dark

SITE # 3

10 Accidents total
40% Northbound
20% Icy or Snowy
30% Dark

SITE # 8

18 Accidents total
39% Northbound
28% Icy or Snowy
22% Dark

SITE # 4

26 Accidents total
54% Northbound
35% Icy or Snowy
46% Dark

SITE # 9

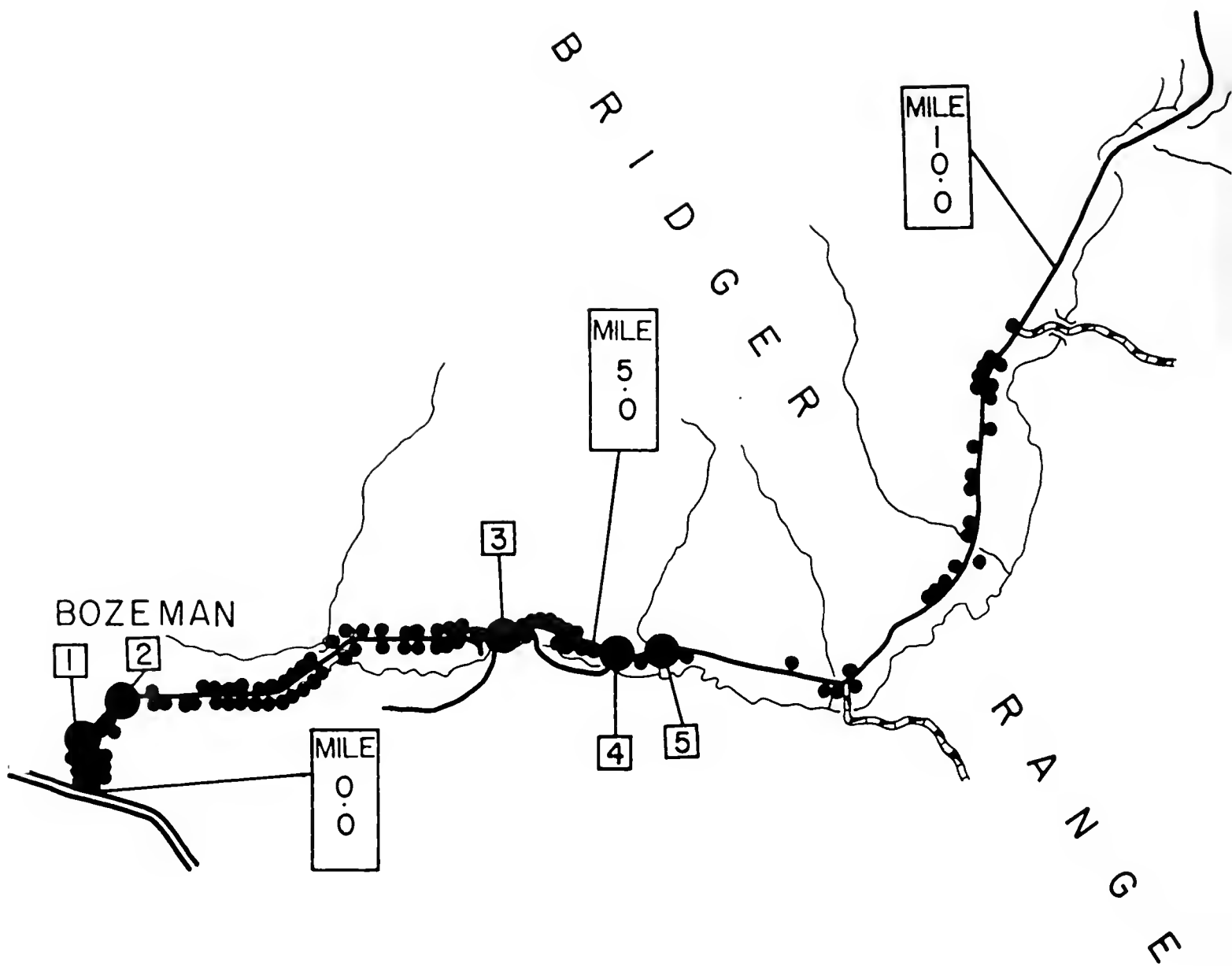
13 Accidents total
38% Northbound
38% Icy or Snowy
23% Dark

SITE # 5

21 Accidents total
76% Northbound
48% Icy or Snowy
38% Dark

Butte East and West
Interstate 15
Milepost 120 - 130
Butte Division

- General: The study section traverses the city of Butte and includes numerous interchnages. High traffic volumes and turning maneuvers attribute in part to the high incidence of accidents. The majority of the roadway in this section was constructed in the 1960's.
- Comment: Clusters of accidents have occured at all the interchange areas in this section. Cluster also occured on the west side of Butte where a left hand off ramp is present. Frequent accident occurance is spread throughout the section.



P 86

- — □ MILEPOST 0 - MILEPOST 10
- ACCIDENT CLUSTER SITES
- INDIVIDUAL ACCIDENTS

Scale: 1 inch = 1 mile

ACCIDENT CLUSTER DETAIL
P 86 MP 0 - MP 10

SITE # 1

17 Accidents total
59% Northbound
47% Icy or Snowy
41% Dark

SITE # 2

7 Accidents total
43% Northbound
29% Icy or Snowy
29% Dark

SITE # 3

20 Accidents total
35% Northbound
65% Icy or Snowy
10% Dark

SITE # 4

8 Accidents
50% Northbound
38% Icy or Snowy
50% Dark

SITE # 5

7 Accidents total
14% Northbound
86% Icy or Snowy
14% Dark

Bozeman (Bridger Canyon)
Mont. 86 (FAP 86)
Milepost 0 - 10
Bozeman Division

General: This study section begins in downtown Bozeman and extends northeasterly through the Bridger Canyon. This roadway is heavily used during the winter months providing access to winter sport areas. The roadway includes a detour section due to a slide condition. The roadway varies in width depending on different construct projects, however, the roadway is a two-lane plant mix surface facility.

Comment: Heavy concentrations of accidents is evident in the first 5+ miles of the section. This can be attributed to, in part, high traffic volumes, intersections and uncontrolled access. A cluster of accidents is identified at the intersection of Mont. 86 and Griffin Drive. A safety project to alter the geometrics of this intersection is planned. A preliminary engineering program for the correction of the slide area at milepost 5+ is also in force. A horizontal curve at Milepost 8.8 - 9.3 has been identified as a high accident rate cluster area and improved advanced warning is planned.

